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Modeling of Reverse Logistics Processes Using Carbon Footprint Measurement

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Abstract

The carbon footprint (CF) is a measure of the total amount of carbon dioxide emissions that is directly or indirectly caused by an production, transportation, storage and utilisation of the products and its packaging in the effect of the product flow in the economy. As excessive carbon emissions can accumulate in the atmosphere and it is considered as the largest contributor to global warming, CF has become a concept widely used in the public debate on responsibility and action to prevent the global climate change. The packaging sector is one of the industries that has recently come under strong pressure from both consumers and legislators to reduce the environmental impact of commonly used packaging by replacing single-use products with reusable ones.

The aim of our research was to verify how the application of appropriate management policies in the reverse logistics processes for used disposable packaging affects the CF level. Additionally, we researched whether the CF level (characteristic for the disposable packaging) can be reduced to CF levels that can be reached by usage of the reusable packaging. In our study, based on the concept of the reverse logistics, we compared the life-cycle environmental impact of two beverage packaging materials: polyethylene terephthalate (PET) and returnable glass.

The calculation of CF can be approached methodologically form two different directions: bottom-up based on process analysis or top-down based on environmental input-output analysis. We collected detailed data from the biggest manufacturers and distributors

operating in the Polish market, supplying the food products to ca. 38 mln of citizens. Then we used it for detailed comparative analysis by calculating CF emissions at each stage of the process (bottom-up approach).

The research led to the development of a model and cradle-to-grave life cycle analysis system for selected products using glass and PET packaging. The versatile parameterisation of the system allows the tool to be used in different economic and geographical realities and can be an effective decision support system for managers and legislators.

Keywords: carbon footprint, reverse logistics, modeling, cradle-to-grave analysis, PET, glass, environmental impact

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